INFRASTRUCTURE ITALIA LAND 5 Srl
Via del Bosco Rinnovato, 6 Palazzo U4
20090 Assago (Milano)

MECHANICAL SYSTEMS

Technical Report
Construction of new Data Centre
Via Galileo Galilei, snc,
20052 – Vignate (MI)

RIBA4

Documento: 4025 ES E RM 09-

Data
October 11th 2024

Firmato digitalmente da:
Roberto Cereda
Data: 01/08/2025 12:51:19

The technician
Eng. Roberto Cereda

Signature

SOMMARIO

1.	GENERALITIES	4
1.1.	Preface	4
2.	WASTEWATER DESIGN CRITERIA	6
2.1.	FOUL & WASTE	6
2.2.	CONDENSATION	7
2.3.	RAINWATER SYSTEM	7
3.	WATER SERVICES	7
3.1.	DESIGN CRITERIA	7
3.2.	WATER SUPPLY	8
3.3.	FIRE SUPPRESSION SYSTEM MAKE-UP	9
3.4.	BIB TAPS	9
4.	Classification of the water to be disposed of	9
4.1.	PUBLIC WASTEWATER LINE	9
4.2.	SETUP OF THE BLACKWATER COLLECTION SYSTEM	11
4.3.	SIZE OF DRAINAGE SYSTEM (GRAVITY BASED)	11
5.	SETTING UP THE STORMWATER COLLECTION LINE	14
5.1.	Setting up the roof stormwater collection system	15
5.2.	Definition of Flow Rates Based on UNI EN 12056-3	15
5.3.	Verification of Outflow Nozzle Sizing	16
5.4.	Verification of Downspout Sizing	16
5.5.	Sizing of Horizontal Collectors	16
5.6.	Setting Up the Stormwater Collection Network for Treatment	17
5.7.	Definition of Flow Rates	17
5.8.	Network Sizing	18
5.9.	Collection Elements	19
5.9.1.	Continuous Grated Channel	19
5.9.2.	Discontinuous grated rain gutter	19
5.9.3.	Checking the runoff capacity of the drains.	19
5.10.	Sizing of glycol tank	21
5.11.	Treatment System for Yard, Roadway, and Parking Lot Runoff	22
5.12.	Verification of the Capacity of the Grit Chamber	22

5.13.	Verification of the Capacity of the Oil Separator	22
5.14.	Diesel containment	22
5.15.	Urea Containment	23
5.16.	Lamination activities	24
5.16.1.	Infiltration box	24
5.16.2.	Lamination tank	24

1. GENERALITIES

This document **4025 ES D RM 09-** is an integral part of the final design of the mechanical systems, in compliance with Ministerial Decree no. 37 of the January 22nd, 2008, relating to the construction of a new site for data center use, located in Galileo Galilei Street which is in Vignate (MI); this project was drawn up by Lombardini22 S.p.A. with registered office in via Lombardini 22 in Milan.

This volume, together with the remaining volumes of the specification, the attached drawings, and the documents produced by the Client relating to the general conditions of supply, must be countersigned for acceptance on each page and returned to the Client. The examination of all documents is therefore a prerequisite for the listing and execution of the plants. Everything contained in it is also essential for the correct reading of the indications and prescriptions contained in the other project documents. If there are any doubts about the correct application of their content, the designer must be informed so that he can give the necessary clarifications in time.

The designer cannot be held responsible for any consequence whatsoever, due to failure to comply with the above.,

This submission has been prepared to provide an overview of the external systems, with the understanding that the RIBA4 Site project has not yet been finalized. As such, minor adjustments to the external networks may be required, particularly regarding their integration and coordination.
It is the responsibility of the General Contractor, during the RIBA5 design phase, to ensure that the systems are coordinated and compliant with the final RIBA4 project for the entire site. This includes alignment with the "CSA Drawings", "Telecom Design" and "Security Design" projects. Any necessary adjustments will be conducted in full compliance with the requirements and project needs defined in the RIBA4 design.

1.1. Preface

This document refers to the design of underground utilities for the electrical and special systems of a site consisting of a building (MIL05A) used as a data center. The site includes the future construction of a second building (MIL05B), also intended to be used as a data center (subject to a future contract).

As defined with the client, the building in question will have 8 data halls, each identified by a code as shown in the image below. Each data hall corresponds to a reference IT power of 6MW.

The building in question has been designed to be constructed in different and successive phases:

1. Shell & Core + Fit-Out of the first two data halls
2. Fit-Out of an additional two data halls
3. Fit-Out of another two data halls
4. Fit-Out of another two data halls

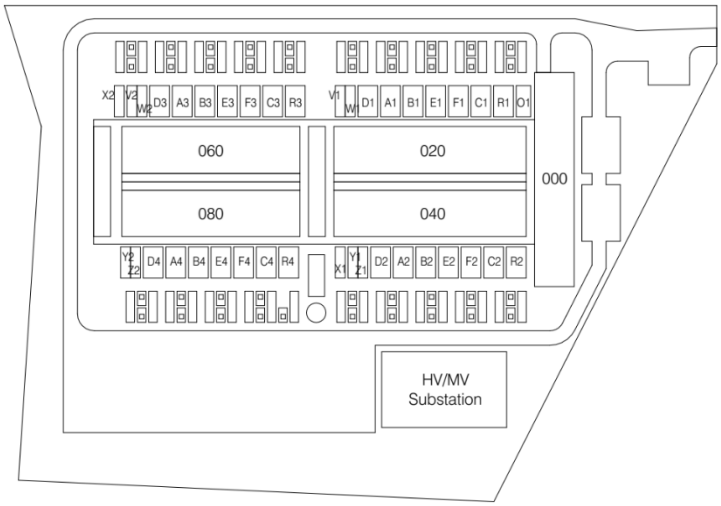
The Shell & Core phase will cover the structural parts of the building (foundations, columns, beams, roof, perimeter walls, and internal partitions, external areas, and provisions for electrical and

mechanical systems). Subsequently, the internal works will be carried out (internal space layout, finishes, electrical and mechanical systems).

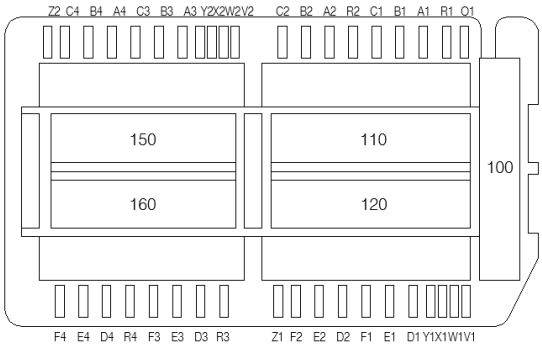
The project has been developed considering a typical module for the space related to a pair of data halls and associated structures (Gantry area, MEP Gallery, power module, and generators). The module includes two data halls of 6 MW each, for a total of 12 MW; this "basic element" has been replicated within the building to achieve the site's overall capacity.

The office block (zone 000 in the image below), on the other hand, follows a dedicated design based on the internal layout of the spaces.

Keyplan MIL05 GF



Keyplan MIL05 1F



Although not proceeding with certification, the project is drafted in accordance with the Uptime Institute's TIER III standard, thus meeting the criteria for concurrent maintainability and additionally for continuous cooling.

The project and subsequent implementation of the systems must take into account the requirements set out by the structural design as summarized in the specialist report.

2. Wastewater design Criteria

The wastewater flow rate will be calculated using the following formula stipulated in EN 12056 – part 2. Typical frequency factors (K) associated with different usage of appliances are given in below table stipulated in EN 12056 – part 2

Usage of Appliances	**K**
Intermittent use, e.g. in dwelling, guesthouse, office	0,5
Frequent use, e.g. in hospital, school, restaurant, hotel	0,7
Congested use, e.g. in toilets and/or showers open to public	1,0
Special use, e.g. laboratory	1,2

We propose the use of 0.5 K value, intermittent use, for office.

Other continuous flow/pumped flow rates shall be added separately where applicable.

Calculation of appliance and sanitary fixtures drainage discharge shall be based on the drainage Discharge Units (DU) of system III, stated in Table below of EN 12056 – part 2.

Sanitary Fixture	**Discharge units**
Wash Hand Basin	0.3
Sink	0.5
Water Closet	2.0
Shower	0.4
Urinal	0.3
Bib tap	1.3

2.1. Foul & Waste

Within the buildings, vented soil and waste drainage system will be provided to serve wash hand basins, sinks, condensate, floor drains and water closets as well as all other sanitaryware appliances and connect to the underground drainage system.

Gravity drainage will be used wherever practical to avoid the need for lifting stations and sump pumps.

Drip trays to be provided within the electrical rooms beneath chilled water pipework that is routed within the space.

Gradient falls for the black water system shall be designed to 1:100 or 1%.

All drainage where possible will be by gravity. All above and below ground drainage systems will be designed to achieve self-cleansing velocity at the design flow rate.

A fuel interceptor strategy will be applied on the site wherever there is risk of fuel contaminants entering the drainage network systems. Passive interceptor systems shall be incorporated within the below ground civil engineering design.

2.2. Condensation

Condensation generated from air-conditioning units will be discharged into the waste drainage system via waterless traps.

Condensate drainage from FWs and CRAH units will discharge into dry trap floor gulleys before connection to the site wide industrial drainage system.

Condensate from the rooftop data hall fresh air handling units will discharge into local stacks and combine with stacks serving the data hall units. Condensate from the rooftop admin fresh air handling unit will discharge into the waste stack serving the welfare facilities.

2.3. Rainwater System

At roof level rainwater will run off to outlets that are located on the building perimeter and connect to stacks that discharge at ground level. Overflow spouts will be provided to ensure continued discharge from roof areas in the event a downpipe is blocked.
Roof rainwater drainage recovery and re-use is being considered for serving bib taps, WC flushing and irrigation.

3. Water services

3.1. Design Criteria

Water Consumption / Storage
The following water storage criteria was used as shown in the UNI9182 Guidelines.

Building/Area	Daily Water Demand
Office	15 to 200 litres per person

Loading Units
Domestic water flowrates will be based upon UNI9182 Guidelines loading units indicated in the following tables.

Appliance	Loading Units Cold	Loading Units Hot	Total Loading Units (Hot+Cold)
WHB	1.5	1.5	2
Sink	3	3	4
WC(Cistern)	5	-	5
Shower	3	3	4
Urinal	0.75	-	0.75
Bib tap	6	-	6

Plumbing fixture flow and pressure limitations
All fixtures will be selected based on maximum allowable flow rates provided in the following table, in-line with UNI9182.

Fixture	Flow rate (calculated at 3bars)	Minimum working pressure (Kpa)
Wash Basin	< 0.1 l/s	100
Shower head	< 0.15 l/s	100
Toilet	< 0.1 l/s	100
Urinal	< 0.15 l/s	100
Sink	< 0.15 l/s	100

3.2. Water Supply

The following domestic water systems will be provided to support the data centre facilities.

Domestic hot and cold-water storage and distribution to welfare facilities for non-critical use.

Non potable water supply from onsite rainwater recovery system to serve bib taps, WC flushing and irrigation.

Domestic Water make-up supply for Chilled water system.

Fire water storage make-up to support wet fire-fighting systems.

The incoming cold-water main enters the site and is routed underground to the building.

3.3. Fire Suppression System Make-Up

Mains cold water will be provided to fire water storage tank for filling of that tank. The connection to municipality and required flowrate will be investigated in next design stage in compliance with NFPA and local codes.

3.4. Bib taps

The water supply serving external bib taps shall be separated from the domestic pipework system utilising back flow preventer (BPV) valves.

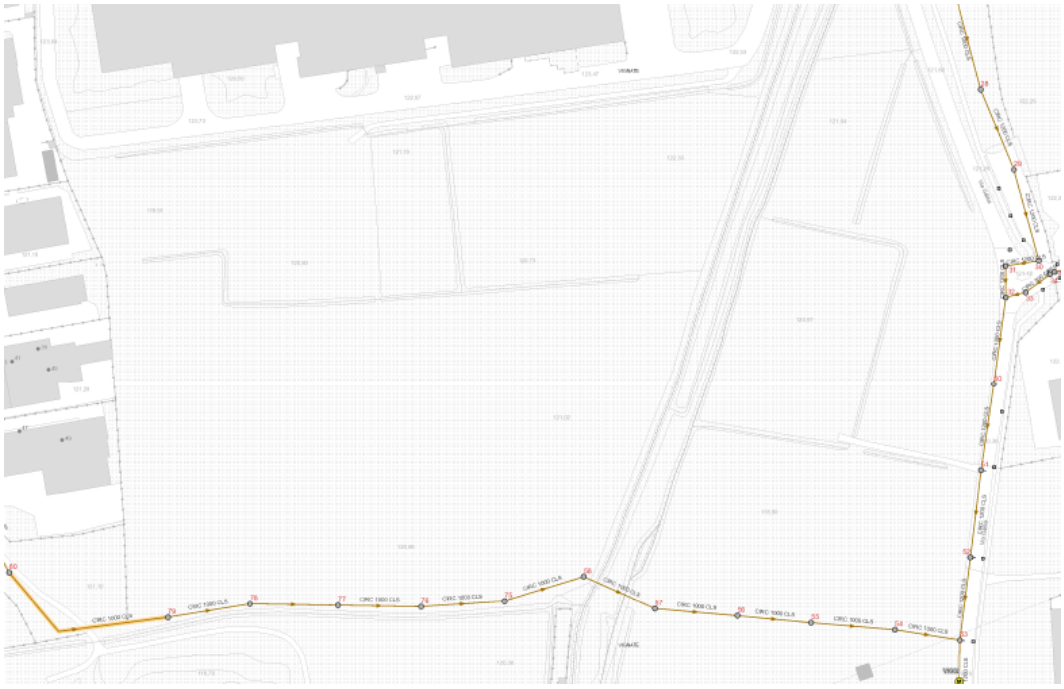
4. Classification of the water to be disposed of

The wastewater to be disposed of will therefore include:

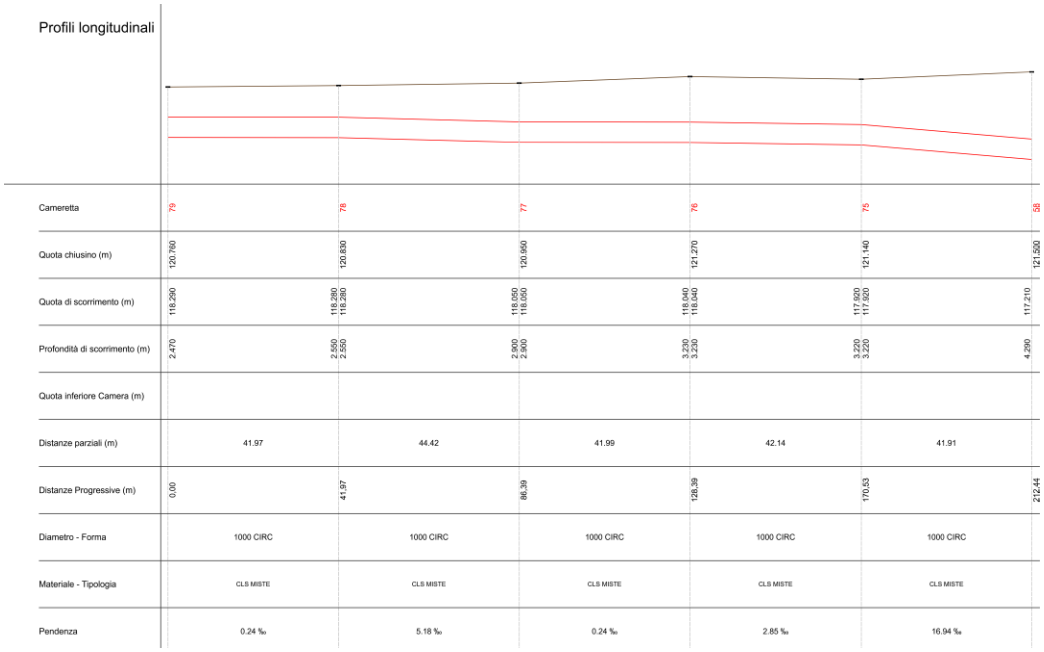
- Effluents from the sanitary facilities for personnel and condensates from the systems;
- Rainwater collected from the roofs of the main building;
- Rainwater collected from the pavements of yards, roads, and parking areas.

4.1. Public wastewater line

Currently, the public sewer system is located to the south of the building at a variable depth ranging from -2.47 m (manhole no. 79), at the first manhole near the intervention area, to 4.29 m at the last manhole before crossing the Busca canal (manhole no. 58).



Public sewer network for black water


Profili longitudinali
Cameretta
Quota chiusino (m)
Quota di scorrimento (m)
Profondità di scorrimento (m)
Quota inferiore Camera (m)
Distanze parziali (m)
Distanze Progressive (m)
Diametro - Forma
Materiale - Tipologia
Pendenza
79 78 77 76 75 58
120.760 120.630 120.960 121.270 121.140 121.500
118.290 118.280 118.050 118.040 117.920 117.210
2.470 2.550 2.900 3.230 3.220 4.290
41.97 44.42 41.99 42.14 41.91
0.00 41.97 86.39 128.39 170.53 212.44
1000 CIRC 1000 CIRC 1000 CIRC 1000 CIRC 1000 CIRC
CLS MISTE CLS MISTE CLS MISTE CLS MISTE CLS MISTE
0.24 ‰ 5.18 ‰ 0.24 ‰ 2.85 ‰ 16.94 ‰

Profile of the public sewer network for black water

The rainwater network will channel the water into a detention basin and subsequently discharge it into the surface water body (Roggia Busca), adjacent to the site.

4.2. Setup of the blackwater collection system

The site envisages the construction of two separate systems: one for collecting effluents from the toilets in the office buildings and changing rooms, and another for industrial water.

The former, being activities akin to domestic ones as per Regional Regulation no. 3 of March 24, 2006, are assimilated to domestic wastewater. The latter will consist of discharge from the industrial plant as follows:

Discharge from the plant (not from heat pumps, but from draining closed circuits, hence not condensation water which is directed to stormwater);

Discharge of softened potable water aimed at reducing hardness (measured in French degrees °f) compared to the incoming water from the water supply, and chemical dosing treatment with anti-corrosive products to protect the plant's pipelines (Dosage: 40 g/m3);

Fire system water discharge;

Discharge of untreated potable water, contained in galvanized steel pipes serving fire systems (sprinklers), during system tests and maintenance operations (e.g., accumulation tank, valve pre-action check);

Local DHW sink discharge;

Discharge of potable water contained in the accumulation system for domestic hot water, subjected to a softening process to reduce hardness (measured in French degrees °f) based on the incoming water value from the water supply, and chemical dosing treatment with anti-legionella products to safeguard user health (Product: sodium hypochlorite solution 15% for use in potable water, 0.4/0.6 ppm).

According to the regulations of the managing body, "new connections of internal sewerage systems to public sewerage systems served by urban wastewater treatment plants must be carried out without the interposition of domestic wastewater pretreatment systems (Imhof, septic tanks, biological)".

The connection of the waste water line are obtained on the permitting stage.
The drainage connection must be activated at later stage.

4.3. Size of drainage system (gravity based)

Once the flow rate has been assessed and the slope 'i' of each conduit has been assigned, the sizing was carried out, referring to the equations of uniform motion according to the Chezy expression.

$$Q = Ks \times A_{cond} \times R_{idr}^{2/3} \times i^{1/2} \ (m^3/s)$$

where
A_{cond} = area of the conduit (m²)
R_{idr}= hydraulic radius (m)
K_s = Strickler roughness coefficient
I=slope of the pipe.

The diameter of the pipes was determined so that the flow was conveyed with a filling coefficient of approximately 50%.

Finally, it was verified that the maximum velocities in the conduits did not exceed 4-5 m/s to avoid erosion phenomena but were still sufficient to prevent sedimentation. Below is the summary of the calculated velocity V (m/s) and flow rate Q (l/s) values for the diameters used, with a slope of 1% and a filling of 50% and 60%.

Φ (mm)	110		125		160	
i	V	Q	V	Q	V	Q
m/m	m/s	l/s	m/s	l/s	m/s	l/s
0.01	1,05	4,43	1,14	6,21	1,36	12,31

Φ (mm)	110		125		160	
i	V	Q	V	Q	V	Q
m/m	m/s	l/s	m/s	l/s	m/s	l/s
0.01	1,13	5,95	1,23	8,34	1.45	16,53

Waste Room

DISCHARGE UNIT	QTY	DU (l/s)	TOT. (l/s)
DRAIN	1	0,2	0,2
			0,2

Guard Room

DISCHARGE UNIT	QTY	DU (l/s)	TOT. (l/s)
WC	1	2	2
WASHBASIN	1	0,5	0,5
			2,5

Discharge Point 1 (GF+1F)

DISCHARGE UNIT	QTY	DU (l/s)	TOT. (l/s)
WC	1	2	2
WASHBASIN	1	0,5	0,5
			2,5

Discharge Point 2 (GF+1F)

DISCHARGE UNIT	QTY	DU (l/s)	TOT. (l/s)
WC	10	2	20
SHOWER	4	0,6	2,4
WASHBASIN	17	0,5	8,5
SINK	1	0,8	0,8
			31,7

Discharge Point 3 (GF+1F)

DISCHARGE UNIT	QTY	DU (l/s)	TOT. (l/s)
WC	1	2	2
WASHBASIN	1	0,5	0,5
			2,5

	DU	l/s
Waste Room	0,2	
Guard Room	2,5	
Offices	36,7	
	39,4	3,138470965

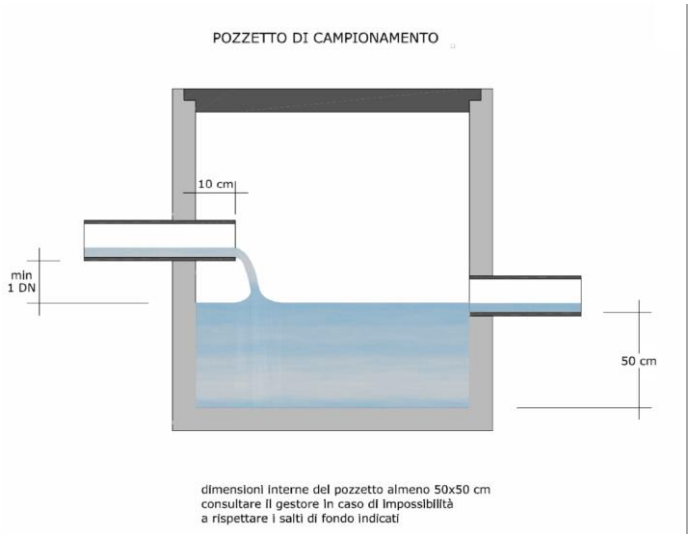
At the end of the line there will be necessity of install lift pumps since the final bottom of pipe quote will be lower than municipality line.

For the sizing of the lift stations, it is necessary to define the usable volume, i.e., the volume between the start and stop levels of the electric pumps.

Since the station planned for lifting wastewater is equipped with 2 electric pumps, one of which is a spare, the minimum usable volume to ensure satisfactory pump operation under the most unfavorable inflow conditions is provided by the formula:

Vu = Qm / (4 x z)
where:
Vu = minimum usable volume of the lift station (m^3);
Qm = average flow rate of the electric pump (m^3/h);
z = maximum number of hourly starts allowed for a pump (assumed to be 6).

Before final discharge into the municipality system, there will be 2 sampling manhole (pozzetti di campionamento), one for each of the 2 system (industrial and waste water). Sampling manhole will be made like below:



5. Setting Up The Stormwater Collection Line

The stormwater collection network scheme involves gravity collection within the Lot and conveyance to a detention basin calculated according to the Regional Regulation of November 23, 2017, No. 7, and subsequently, through a lift station, discharged into the Roggia.
The collection within each individual lot is structured into multiple systems:

- a system for collecting water from the roof of the main building;
- a system for collecting stormwater from the drains serving the internal roads, parking lots, and yards where chillers are located

Water from the roof, being low in contamination, does not require specific treatments. However, for the other two systems, it was deemed necessary to treat the water before discharging it into the public sewer, as it is potentially oily.

All main pipes are made of HDPE with a slope of 0.25% (except where indicated other). The entire network will be inspectable through inspection chambers made of reinforced concrete elements, with horizontal sections of 0.80 m x 0.80 m, 1.00 m x 1.00 m, and 1.50 m x 1.50 m. The chambers will have a drivable top slab, a manhole shaft with a ladder, and inspection covers made of spheroidal graphite cast iron according to UNI EN 124, class D400, with a manhole diameter of 600 mm

In the settlement in question, even though the activity to be established does not fall under those listed in Article 3 of the Regional Regulation of March 24, 2006, No. 4 – Regulation of the disposal of

first rainwater and washing of external areas, a first rainwater collection system is planned due to the need to fuel the generators with diesel.

Cooling systems are positioned in the yards, where glycolate water is present. As a precaution, collection tanks have been placed at the end of each collection channel to manage any potential spills of this glycolate water.

5.1. Setting up the roof stormwater collection system

The buildings have flat roofs with side parapets and no gutters. The downspouts will be located externally and equipped with an external box. Overflow outlets will be present along the entire perimeter of the building. Near the offices, the collection will be directed only on one side towards the data hall.

The downspouts will be interrupted about 30 cm from the inspection chamber at the base, which will be equipped with a closure grid. The roof has an area of approximately 14,640 m².

The building has been divided into modules of roughly the same size, and this division has also been applied to the downspout collection network. For each module, the scheme includes a DN 250 HDPE pipe with a 0.5% slope, starting from the inspection chamber at the base of the downspouts and conveying the water to the main collector located in the middle of the yard. The main collector is also made of HDPE with a 0.25% slope and variable diameters from DN315 to DN630.

The roof water is conveyed into a storage system that allows for subsequent reuse for irrigation, yard washing, and reuse in toilet flush tanks. Excess water will be conveyed into the lamination tank (detention basin) through an overflow.

For the sizing of the elements, the flow rates were calculated based on the UNI EN 12056-3 standard.

5.2. Definition of Flow Rates Based on UNI EN 12056-3

According to the standard, under steady-state conditions, the stormwater flow rate to be drained from the roof must be calculated using the formula:
Q = r x A x C x k

Where
Q is the rainwater flow (l/s)
r is the rainfall intensity (l/(s·m²)
A is the effective roof area (m²)
c is the runoff coefficient (= 1 dimensionless)
k risk coefficient assumed to be 1
The rainfall intensity (r) was derived from Table 1 of the Standard, as shown below: Rainfall intensity (r) = l/(s * m²)

0,010

0,015
0,020
0,025
0,030
0,050
0,060

As a precaution, given the type of intervention, a value of (r) of 0.06 l/(s·m²), equivalent to 216 mm/h, was assumed. Based on the adopted downspout scheme shown in the drawings, the area served by each downspout was calculated.

5.3. Verification of Outflow Nozzle Sizing

The adopted outflow nozzles are conical to reduce the diameter of the underlying downspouts. The assumed and verified dimensions are:

- Lower edge width: 17 cm
- Upper edge width: 24 cm
- Height: > 24 cm

5.4. Verification of Downspout Sizing

For the sizing of the downspouts, based on the calculations, a reference area of 953 m² was assumed, resulting in a flow rate of 57.18 l/s for the office area. For the rest of the roof, the maximum reference area is 700 m², resulting in a flow rate of 42 l/s.

The sizing of the downspouts was based on the UNI standard table, which assigns a maximum flow rate to each diameter depending on the fill level, which can range from 0.20 to 0.33. In the absence of specific indications, a fill level of 0.33 was assumed.

According to the table, with a diameter of 190 mm and a fill level (f = 0.33), the maximum capacity of the downspout is 59.3 l/s, which is higher than the flow rate of 57.18 l/s. Similarly, with a diameter of 170 mm and a fill level (f = 0.33), the maximum capacity of the downspout is 44.1 l/s, which is higher than the flow rate of 42 l/s.
As an annex, the dimension verifications carried out according to the UNI EN 12056-3 standard are provided.

5.5. Sizing of Horizontal Collectors

From the inspection chambers at the base of the downspouts, 250 mm diameter HDPE pipes originate and, through additional inspection chambers, converge into an adjacent HDPE collector running under the concrete yard.

For the sizing of each section of the main collectors, the cumulative flow rate from the downspouts was considered, assuming a constant slope of 0.25% and a fill level of 75%.

The calculations for sizing and verification are provided in Annex B.

At the end of each yard, a 630 mm diameter conduit leads to the main collector beneath the roadway. The following table shows the velocity and flow rate values for the diameters used, for HDPE pipes with the assumed slope and fill level.

· cm	315		400		500		630		935		1200	
i	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q
m/m	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s
0.0025	1,13	52,96	1,33	101,39	1,54	182,99	1,76	321,67	2,33	940,54	2,70	1705,31

5.6. Setting Up the Stormwater Collection Network for Treatment

Water from the road and parking lot will be collected in main collectors through drains placed approximately every 20 meters, considering the interferences of various existing underground services, and ensuring draining surfaces of less than 400 m² per drain. Inspection chambers are planned at the points where the water enters the collector.

The HDPE collectors will have a constant slope of 0.25%. The pipes from the drains will be made of PVC. For the collection from the yards, grated channels will be installed.

Stormwater from roads, parking lots, sidewalks, and yards, as previously mentioned, even though not listed among the activities in the Regional Regulation of March 24, 2006, No. 4, will be subject to first rainwater treatment as a precaution.

According to the regulation, "the stormwater drainage network must be sized based on short-duration and high-intensity rainfall events characteristic of each area, and in any case, assuming that the event occurs within fifteen minutes.

The draining surfaces are represented by:

- internal roads;
- plant yards;

The contiguous permeable surfaces (green areas) have not been considered, as a physical boundary (prefabricated curb) will be placed between the impermeable and permeable areas to prevent any percolation from the latter onto the former, ensuring that they are managed on-site without being directed to the surface water drainage network.

5.7. Definition of Flow Rates

To size the stormwater drainage system, it is necessary to estimate the amount of rain the system must handle during the most intense precipitation events.

For determining the peak flow rate, the following formula was used:

Where
Q is the rainwater flow (l/s)
r is the rainfall intensity (l/(s·m²)
A is the effective roof area (m²)
c is the runoff coefficient (= 1 dimensionless)
k risk coefficient assumed to be 1

For the sizing, a rainfall intensity of 216 mm/h, equivalent to 0.06 l/(s·m²), was assumed, as used for the sizing of the downspout network.
The areas served and the calculated flow rates for each section are provided in the annex.

5.8. Network Sizing

For the sizing of the pipes, the following factors were considered:

- Pipe fill level equal to 75% of the effective section;
- Slope of 0.25%.

The following table shows the velocity and flow rate values for the diameters used

· cm	315		400		500		630		935		1200	
i	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q
m/m	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s
0.0025	1,13	52,96	1,33	101,39	1,54	182,99	1.76	295.35	2.06	555.49	2.56	1112,53

5.9. Collection Elements

5.9.1. Continuous Grated Channel

The continuous grated channel is used to collect water from the yards, at the base of the loading bay, and at the entrance.

The results of the verifications are provided in the annexes.

5.9.2. Discontinuous grated rain gutter

The grated discontinuous storm drain is used to collect water from the internal roadway and parking area.

Stormwater drainage runoff from the roadway is through prefabricated concrete gutters until it reaches the storm drains. The designed gutters have plan dimensions of 1000mm x 500mm or 500mm x 500mm and runoff width of 400mm and runoff depth of 25mm. The drains will be 50x50 cm in size and will be concave type when placed at the gutter and flat type in other cases.

5.9.3. Checking the runoff capacity of the drains.

following formula is considered for the verification of the fall pipe:

$$Q = k * A * h1/2 * \eta$$

in which:

A is the free area of light;
K is a constant equal to 2.96 in the SI;
η is a reductive coefficient to account for possible grid clogging.

By adopting concave 0.50x0.50-cm machicolations, we have:

k = 2.96 efflux coeff.
h = 0.75 reductive coeff.
h = 0.01 m hydraulic head
b = 0.50 m fall base
h = 0.50 m drop height
a = 30% percent clear span
A = 0.09 sq m free area
Q = 16.65 l/s disposed flow rate

Interdrain spacing 20 m
i = 213.38 mm/h rainfall intensity for tc=5min
· = 0.9 inflow coeff.
L = 8 m roadway width

I = 20 m wheelbase
Q = 8.54 l/s flow rate for disposal

5.10. Sizing of glycol tank

Considering the presence of cooling systems on the mezzanines of the yards, where glycolate water is present, it was deemed prudent to include collection tanks in case of spills.

The operation of this "emergency" system involves the installation of tanks sized for first rainwater. In the inspection chamber at the end of the channel, there are two valves. Under normal conditions, these valves allow water to flow into the main collector. In case of a spill, the valve to the main collector will be closed, and the valve leading to the tank will be opened, allowing the first rainwater to flow into the tank. Once the maximum level in the tank is reached, the subsequent rainwater will continue to flow into the detention basin.

As previously illustrated, each yard is divided into two collection areas with a central channel. For the tank sizing, the maximum area served by a single channel, which is 2,209 m², was considered. Each chiller unit has a capacity of about 1000 liters, and the distribution of the units is shown in the drawings.

The tanks will be positioned at the left end of the yard indicated on the drawings, at the right end of the yard, and one in the central position to collect any spills from the systems located in the central areas of yard.

The side tanks will be sized to collect the glycolate water content of a maximum of one chiller, plus the rainfall event calculated as 5 mm of precipitation over the area of influence.

Vtank= Vs + Vi
Vs = 2'140 0,005 = 10,7 m³
Vi = 0,80 m³.
The minimum volume necessary is 11,5 m³ rounded up to 12 m³.

Vtank= Vs + Vi
Vs = 4280 x 0,005 = 21,4 m³
Vi = 0,80 m³.
The minimum volume necessary is 22,2 m³ rounded up to 23 m³.

In case the tank is used, it must be emptied, after analysis, by direct extraction using a pump. If the water analysis does not reveal any contamination or if the results are compatible with discharge into a surface watercourse, the extracted water can be reintroduced into the downspout network or onto the road.

The tanks to be installed are monolithic modules made of precast concrete.

5.11. Treatment System for Yard, Roadway, and Parking Lot Runoff

According to Regulation R.R. No. 4/2006, "stormwater runoff from surfaces contaminated by mineral oil hydrocarbons, as an alternative to the separation of first rainwater, can be treated in continuously operating plants, designed based on the maximum estimated flow rate in connection with the meteorological events referred to in paragraph 3, while still complying with the emission limit values referred to in Article 7, paragraph 1."

The treatment plant consists of a sand removal phase and an oil removal phase with a coalescence filter.

5.12. Verification of the Capacity of the Grit Chamber

Grit removal is a physical pretreatment process for removing all substances with a specific gravity greater than water (stones, sand, leaves, etc.) originating from the runoff of covered or uncovered surfaces (roads, parking lots, warehouse and depot yards) and washing areas. The grit chamber is a settling tank where the fluid velocity is reduced, allowing the suspended solids to settle and accumulate at the bottom of the tank.

The verification of the sedimentation tank size is done using the following formula:

Vs = Ts x Q

Vs= Separation volume
Ts= 5 min (Separation time)
Q= Flow rate

5.13. Verification of the Capacity of the Oil Separator

Oil separators with coalescence filters achieve higher removal efficiencies for light substances. The system uses a polyurethane sponge support on which oil and hydrocarbon particles aggregate until they reach a size that allows them to separate from the effluent by gravity. This treatment is recommended when there are particularly stringent limits on the concentrations of mineral oils and hydrocarbons in the discharge.

In this case, the oil separator is sized for the first flush flow only. The verification of the oil separator size, only for a flow rate related to the first flush (5 mm in 15 minutes), is done using the following formula

$$NS = (Qr + Qs \times fx) \times fd$$

Qs= 0
Fd= 1

5.14. Diesel containment

Following the requests received from the competent authorities (MASE) regarding environmental matters, it is necessary to install a diesel containment system in case of accidental failure.

For this reason, four diesel loading zones have been identified where a maximum of two vehicles can park for tank filling operations.

The diesel truck will park in this designated area on the road, present at each of the 4 gantries around the building.

The area is physically delimited by drainage channels that will collect the spilled diesel on the roadway and direct it to a drain located at the roadside.

Downstream of the drain, there is a Y-branch.

Under normal conditions (no spillage), rainwater flows into the discharge line.

In the event of an accidental diesel spill, the line will be diverted to an underground tank made of internally waterproofed concrete with a volume of 30 cubic meters. This volume will be able to contain 1/3 of the diesel tank plus any moderate-intensity rain.

Additionally, a volume of about 1000 liters has been considered for washing the yard and pipes post-spillage.

The flow will be diverted through a pair of motorized valves, which will be manually activated by the operator present during the diesel loading operations.

The valves will be mounted both on the "normal" discharge line and on the line directed to the underground tank. In rainy conditions without diesel loading operations, water flows towards the line up to the oil separators present before the detention basins, and the line towards the diesel tank will be closed.

In addition to this system (which only manages accidental spills), all rainwater discharged onto the yards and roads will be treated with continuous oil separation systems before being discharged into the detention basins and then into the ditch.

There will be no spring closure systems or other mechanisms in case of power failure to the valves. Instead, it will be possible to unlock the servomotor and manually operate the valves if necessary.

5.15. Urea Containment

The project does not include a urea storage system, used as SCR on the generator exhausts. However, provisions are in place for future installation by the end customer. The tanks designed to contain glycol and diesel will also be used for urea containment in case of accidental spills.

5.16. Lamination activities

Flood mitigation structures designed to reduce rainwater and stormwater flow rates within certain limits represent the most numerous families of flood mitigation techniques. These structures temporarily store a significant portion of the water volumes from rainfall events, to later send them for treatment or return them to the final receptor at a reduced and compatible flow rate. Storage structures also include those that do not discharge downstream but empty through infiltration.

In general, the classification of flood mitigation works is based on different criteria, briefly described below:

- Function performed: DETENTION or RETENTION
- Position relative to the drainage network: TRANSIT (in-line) or CAPTURE (off-line)
- Position relative to the ground level: SURFACE or UNDERGROUND

In this specific case, considering the groundwater level and soil characteristics, underground structures distributed across the site will be used, which will partially disperse through infiltration and partially discharge into a surface watercourse.

According to the hydraulic invariance report, the total volume to be mitigated will be approximately 4,180 m³, distributed as follows:

- Detention basin located to the south: 2,450 m³ with a discharge rate of 38.1 l/s
- Infiltration basin located to the east: 1,220 m³
- Infiltration basin located to the west: 510 m³

5.16.1. Infiltration box

The infiltration basins will be made up of the Stormbrixx HD900 modular system. The west basin will consist of 792 modules laid out in two levels:

- Physical volume = $792 \times (0.604 \times 1.207 \times 0.92 \times 2) = 531.18\ m^3$
- Useful volume = $531.18 \times 0.97 = 515.24\ m^3 > 510\ m^3$

The west basin will consist of 1900 modules laid out in two levels:

- Physical volume = $1900 \times (0.604 \times 1.207 \times 0.92 \times 2) = 1274.34\ m^3$
- Useful volume = $1274.34 \times 0.97 = 1236.11\ m^3 > 1220\ m^3$

5.16.2. Lamination tank

The lamination tank will be constructed using prefabricated reinforced concrete boxes with dimensions of 300 cm x h.150 cm x L.200 cm – thickness 20 cm, while the boxes with inlet and outlet pipes will be 300 cm x h.300 cm x L.200 cm – thickness 20 cm. The inlet and outlet pipes must be made of smooth HDPE.

Refer to the specifications for further details.

The basin will be emptied by means of a lift station installed directly in the modules of the detention basin.
The pumps, one as a backup and the other in service, will pump the water into the nearby Roggia.

At the time of delivery of RIBA4 Stage for UG Services, there is no evidence of a written agreement between the property owners and the managers of the Roggia Busca for water discharge.

However, in the months preceding the delivery, preliminary verbal agreements has already been undertaken for the discharge into the Roggia with the flow rates indicated in the hydraulic invariance report.

6. Annexes

- Calcoli caditoie
- Calcoli disoleatori e dissabbiatori
- Calcoli griglie
- Calcoli pluviali
- Calcoli rete pluviali